

Six-Sigma Implementation through Competency Based Perspective (CBP)

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ABSTRACT *The popularity of six-sigma has given rise to the question: can any company adopt this rigid data driven approach to achieve higher levels of quality? This research suggests that a company must develop a unique combination of resources and competencies to realize the benefits of six-sigma. According to the competency based perspective (CBP), a company first needs to have the assets, skills, and resources to launch the six-sigma program, and second, it needs to have the expertise to integrate these assets to orchestrate a cohesive implementation of this program. The paper makes the case that most successful six-sigma adopters had initially implemented Total Quality Management (TQM), Baldrige, or some other quality initiative, preparing them to launch this data driven, process oriented approach. For companies that have emphasized quality function deployment (QFD), innovation and problem solving, statistical process control, process capability studies, etc. a transition to six-sigma would be a natural course of action. For others where these practices are at an incipient stage, six-sigma progress can be extremely slow and frustrating. The paper validates these comments with the help of a case study. It was easy for the study company to make the transition to six-sigma because it had captured enough process performance data, customer requirements, infrastructure and leadership development through its long history of quality initiatives.*

Introduction

Contrary to popular opinion, the Six-Sigma quality program is not just a method of measuring and controlling failure rates. It includes incorporating a wide range of tools and methodologies into an organization in order to improve performance and, ultimately, significantly improve customer service and profits. Six-sigma requires cultivation of innovation, radical improvements in product and service design, hefty reduction in process variation, and offering exciting products/services to the customer. Literature quotes substantial quantifiable result with regard to savings achieved by companies adopting the six-sigma approach (Motwani *et al.*, 2004; Antony and Banuelas, 2001; Gabor, 2001; Coronado and

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Antony, 2002). The question thus arises, can any company adopt this rigid data driven approach to achieve higher quality performance? We offer the suggestion that a company must develop a unique combination of resources and competencies to bring home the benefits of six-sigma. For novice companies that are embarking on a quality program for the first time six-sigma can pose to be a challenge. Six-sigma takes a proactive approach by focusing on prevention of system defects, thus, for a company that is yet to address process control and process capability aspects of a quality program six-sigma will be a burden. The goal of six-sigma is obviously business excellence, but before embarking on such a program, companies must look at the bigger picture. Six-sigma appeals to reason more because it is a comprehensive yet flexible system to achieve business excellence. As opposed to TQM, six-sigma takes a staggered improvement approach that uses customer preferences, non-intuitive data driven methodology, statistical evidence of quality, diligent attention to detail, and above all, uses economic justification for each improvement effort. Six-sigma adopters must understand that it is lot more than just use of tools and techniques. The approach integrates strategic issues, technology, statistical tools and techniques, and people and training (Black and Green belt).

In order to implement a six-sigma program successfully a company needs to have certain competencies. Based on the works of Dean and Bowen (1994); Sitkin *et al.* (1994); Kanji (1996); Wilkinson *et al.* (1998); and Oakland (2000) as reported in Esrig-Tena and Bou-Llusar (2005) a company needs to bring together four sets of principles and practices to cause a quality initiative to succeed. These are customer focus, continuous improvement, employee fulfillment, and viewing the organization as a total system; Esrig-Tena and Bou-Llusar (2005) labeled them as the competencies associated with quality management. The needed competencies can be viewed from two different perspectives, namely: (i) as assets, skills, or resources belonging to the company that allow an activity to be performed systematically, and (ii) the firm's ability to integrate the assets and orchestrate a cohesive implementation of the program. According to the Competency Based Perspective (CBP), a company must develop a unique combination of resources and capabilities that enables it to obtain regular incomes based on the possession of competencies (Barney, 1991; Grant, 1991; Peteraf, 1993). Bogner and Thomas (1994, p. 113) identify the cognitive aspect, which is related to the knowledge and the skills the firm possesses, and the action aspect, oriented toward the activities the firm undertakes, as essential prerequisites for launching such a strategic initiative. Based on this view, competency for an initiative such as Six-Sigma can be defined as the abilities and specific skills that the firm possesses in the deployment of its resources, as well as its cognitive characteristics, which are geared toward the accomplishment of six-sigma results.

Numerous studies suggest that quality is an important competitive advantage that leads to improvement in performance (Belohlav, 1993; Wruck and Jensen, 1998; Huq, 1995). It is generally accepted that failures in quality improvement programs are not because of basic flaws in the principles of quality concepts, but are due mainly to lack of competency and ineffective implementation systems (Boerstler *et al.*, 1996; Brannan, 1998; Shin *et al.*, 1998; Zabada *et al.*, 1998).

Authors such as Ericksen and Mikkelsen (1996, p. 58) and Sanchez *et al.* (1996, p. 8) offer the opinion that competencies are pools of resources that enable a company to perform specific functions, they also emphasize that the competencies must have an organizational component, management must deploy these assets/competencies in a coordinated manner to attain specific goals. A holistic approach to six-sigma implementation is predicated not only on competencies, i.e. knowledge, skills, cognitive ability, resources, and proper deployment of the principles, but also on regarding it as part of the company strategic and tactical plan for improving cost performance and customer service. The paper makes a case for Competency Based Perspective (CBP) approach for implementation of Six-Sigma. The following sections examine the competencies needed for Six-Sigma, and finally, a model Six-Sigma implementation is presented that authenticates the approach presented in the paper.

Six-Sigma a Natural Transition from TQM

Success of a six-sigma program is dependent on the right selection and prioritization of projects, and this is the most critical decision a six-sigma team has to take. In many cases, this decision is made on subjective judgment or the project benefits are estimated under false or untenable assumptions. The firm must have in-house expertise to apply analysis tools such as NPV, IRR, payback period, etc. to determine the financial viability of the selected projects. Like TQM, Six-Sigma also emphasizes leadership, but the emphasis is more passionate and institutionalized than TQM. Six-Sigma goes through a more regimented leadership structure by creating a cadre of professional leaders in the firm. Coupled with this structured leadership and a passionate concern for company bottom-line, Six-Sigma focuses more on the process elements (process management, statistical analysis of process data, the measurement system analysis) than TQM.

Coronado and Antony (2002) in their exploratory study on critical success factors for Six-Sigma implementation show that without the necessary ingredients successful implementation of Six-Sigma may remain elusive. Among the critical success factors they list management involvement and commitment *vis-à-vis* leadership, cultural change, communication and training, necessary organizational infrastructure, linking Six-Sigma to business strategy/customers/suppliers, and project management skills. Literature also suggests that successful implementers such as Motorola, GE, Allied Signal, Citibank, and Sony had the required infrastructure for adopting Six-Sigma (Antony and Banuelas, 2001). The link between Six-Sigma and business strategy should be clear because Six-Sigma is the bond between customer expectations, core processes, and competitiveness (Pande *et al.*, 2000). Before implementing Six-Sigma, the Ford Motor Company had successfully implemented TQM (Gabor, 2001). Ford found that Six-Sigma is more structured and profit oriented than TQM because as opposed to TQM Six-Sigma looks at the impact of a process improvement on profit and competitiveness. Both TQM and Six-Sigma try to link with customers (Ex. Quality Function Deployment). Determination of customer expectations can be a challenging task given that they are often poorly defined, ambiguous, and subjective. Six-Sigma moderates this situation by focusing on a single critical-to-quality (CTQ)

characteristic as opposed to total product quality approach in TQM. Westin Hotels was able to measure such CTQ's through Six-Sigma approach (Eckes, 2000). Since Six-Sigma is a data driven approach, companies where data collection/management is at an incipient stage the project progress can be extremely slow and frustrating. Motwani *et al.* (2004) report that the success of Six-Sigma at Dow Chemicals was preceded by a successful TQM implementation implying that a company that has emphasized problem solving through TQM implementation is ready to emphasize breakthrough rates of improvement and innovation. Before a company attempts breakthrough rates of improvement, i.e. 3.4 DPMO, it must achieve standard performance, i.e. ISO 2000. TQM offers a vast set of tools and techniques in a poor goal-setting environment, while Six-Sigma harnesses the powers of these tools and techniques in a clearly defined framework for using them to achieve measurable business results. A company with a history of quality initiatives, the likes of TQM, a transition to Six-Sigma would be a natural course of action. Motwani *et al.* (2004) report on a number of companies, that had developed the competency to implement Six-Sigma, and eventually made the transition from generic TQM to more focused Six-Sigma.

All quality programs represent a change from the way things were done in the past. Successful implementation of quality systems, i.e. TQM, Baldrige, ISO 2000, or Six-Sigma, means making them a permanent part of how things are to be done in the company. Most changes in organizations have a social component because the change usually involves people. Management must become cognizant and accordingly, plan for the social challenges that will arise from proposed change initiatives. In order to motivate the employees in the use of TQM, Six-Sigma and other practices more effectively, i.e. create the cultural conditions; literature suggests three methods of increasing employee motivation (Oliver, 1996; Schuster and Zingheim, 1992). These authors suggest incentive based compensation, employee ownership/stock option plans, and performance appraisal based on team performance. Although the most common method of instilling a sense of ownership among employees is through an offer of stock options, in many situations it may not be practical. Oliver (1996) has suggested that these quality programs work best when compensation is based on team performance. If a firm's culture refuses to accept changes required by Six-Sigma, then such an initiative will fail regardless of the desires and efforts of top management. In the end, the only way to bring about lasting change that will support the Six-Sigma initiative is to create a working culture in which employees can utilize Six-Sigma practices more effectively. It is easier for a firm to create such a culture when a quality sub-culture already exists in the company. The reason GE, Motorola, Du pont (Motwani, 2004) were successful with Six-Sigma because of existence of such a sub-culture.

Six-Sigma Implementation – A Case Study

The selected model is a teaching hospital that started its quest for quality twenty years ago with continuous quality improvement (CQI). Ten years later the hospital initiated its TQM program. The managers and the physicians in this hospital considered TQM primarily as a strategic tool for improving quality and price

competitiveness of the business and they were fully aware of the inter-relatedness among different TQM activities. They focused on the future with many of their decisions not only improving the current performance, but also better positioning the hospital for future competition. After the strategic issues in TQM were resolved, the hospital proceeded to address the tactical issues to get everyone involved. They launched a data driven decision-making process based on an objective measurement criteria to monitor processes and outcomes. Strategies for defining data requirements and information systems support were developed during the initial TQM planning process, along with strategies for effectively dealing with the cultural barriers. Six years later the hospital determined through a Quality Function Deployment (QFD) study that it has to move to higher standards in its patient care processes to position itself as the premier hospital in the region.

The hospital began to implement Six-Sigma from 2002, by that time they already had a quality infrastructure in place. TQM had prepared them to keep the customer focus, to improve continually, to focus on employee fulfillment, and to regard the organization as a total system. Consistent with CBP their long experience with several quality management programs had prepared them for a cohesive implementation of Six-Sigma. The reasons for their selection of Six-Sigma were attributed to: (1) its ability to focus on small segments/functions within the hospital; (2) as opposed to TQM, its obsession with company bottom line; and (3) its ability to guide a company to approach zero defects. Management decided that Six-Sigma is the way to achieve strategic separation of the hospital from its competitors. They found that Six-Sigma is a non-intuitive, data-driven, focused solution approach for improving efficiency and effectiveness continually.

In selecting Six-Sigma, the top management realized that they have the assets, skills, and the resources needed to implement it through their years of experience in TQM and BPR. The hospital had already attained a pervasive culture where all functions and activities shared a fundamental belief in total customer satisfaction. Everyone from the board of directors, hospital administrator, physicians, management personnel, to employees had embraced the continuous improvement philosophy and culture where quality is the key. From a strategic point of view the hospital was well positioned to implement Six-Sigma because they emphasized: (1) strategic leadership; (2) participative management (team approach); (3) an explicit focus on internal and external customers; (4) changing the organization structure to better identify and improve processes; (5) establishment of an ERP system that is focused on process analysis and quality; (6) and a workforce culture that emphasized continuous learning, empowerment, and personal responsibility. The hospital was not just happy with correcting present deficiencies or meeting the current standards, they wanted to go beyond the acceptable standards to achieve strategic dominance in the marketplace.

From 1995 to 2002, the study hospital used TQM and ERP as strategic tools to develop its distinctive competencies. The leadership at the hospital – that included both physicians and executives – went through detailed planning before they launched these programs. Strategies for defining data requirements and information systems support were developed during the initial planning process for each of these projects, along with strategies for effectively dealing with the

cultural barriers. At the very outset of each program, the implementation team was concerned with leadership, vested interest in the existing system, internal competition, consensus on issues or problems, and recognition or reward for change. Only after detailed plans were developed to effectively deal with these problems did management look into other barriers such as education and training, denial of problems (we are already doing it right), and continuous improvement. They launched a data-driven, decision-making process based on objective measurement criteria to monitor processes and outcomes. Seminars and group discussions were held to help employees better understand the existing systems and processes and individual roles in quality improvement. To keep the employees informed, the hospital provided a single point of contact through its intranet, where all meeting minutes and memos were posted. A comprehensive training program was launched in which first the department heads and the directors were trained within a year. Next, all managers and supervisors were trained, and finally, all employees were trained within three years. Creation of cross-functional teams with the goals to ensure that jobs, systems, and roles in quality improvement were understood helped eliminate barriers within and among units. These cross-functional teams continuously evaluated systems and processes to ensure that they worked efficiently and effectively to meet customer expectations. Creation of the cross-functional teams also helped in reengineering of several business and care processes that focused on formation of systems and procedures that were simple and user-friendly.

In support of TQM first, and for ERP later, hospital took the additional step to implement a comprehensive, cohesive interdisciplinary system that would support the identification and measurement of specific patient care processes. The result was the development and documentation of a critical path for each volume care process, e.g. coronary artery bypass surgery, which maps out treatments, diagnostics, education, and discharge planning details. The key concept is to identify rapidly any variance, or deviation from the outlined care activities that may alter expected outcomes. These critical paths for the volume care processes helped failure mode and effects analysis (FMEA) and served as a control tool for the DMAIC approach of Six-Sigma. Based on a need assessment, the critical path teams were staffed with surgeons, physicians, nurse specialists, pathologists, lab. managers, representatives from the finance department, representatives from the human resources department, and other needed staff members. Physician involvement and direction from the beginning in these implementations was the key to success because the pathway was driven by the physicians' order set.

Success of TQM and ERP had a dramatic impact on performance and culture of this hospital (Hackman and Wageman, 1995; Lawler *et al.*, 1998). It created managerial and leadership capabilities – an essential requirement for successful implementation of Six-Sigma – that enabled the hospital to make this effortless transition to six sigma. Their managerial capabilities included, among others, steering the company towards a cross-functional team based organization, and arrangements within the organization that alter behavior towards system, processes, and people for successful implementation. By implementing these programs, the hospital achieved a higher level of learning capacity through its

instituted training programs, benchmarking of the best of breed industry practices, and by its constant scanning of the external environment for new developments and opportunities. Edmondson and Woolley (2003) report that new managerial training take root only when the managers have the inclination, background, and the skill to absorb them. The hospital realized that the market conditions in the health care industry change rapidly, making TQM the wrong approach for achieving competitive advantages in the short term.

The study hospital realized that they were putting more emphasis on the outcomes, and not enough emphasis on the process of services offered, as a result, variation in service output remained a common problem. Once the source of the problem is identified, the system can be changed in such a way that it fool-proofs itself to prevent the problem from reoccurring. They realized that the answer to their problems lie in implementation of Six-Sigma, an approach that pinpoints process problems that have the most significant impact on the company bottom-line.

Readiness of the Hospital from Competency Based Perspective

Organization culture determines the success (or failure) of a change initiative by facilitating the organization's ability to learn, share information among its constituents, and make decisions (Kilman *et al.*, 1986). Culture sets both the limits and direction of movement of behavior in organizations such that culture dictates the acceptance or rejection of all organizational paradigm change. An established organizational culture possesses a set of learned consequences based on behaviors. Changing the culture can only be done when employees learn new sets of behaviors (McNabb and Sepic, 1995; Thompson and Luthans, 1990). Workplace culture dictates which behaviors are acceptable, establishes the way problems are addressed, spells out how relationships are defined and supported, and establishes how work is done. Culturally the hospital was ready to make the transition from generic TQM to a more focused Six-Sigma.

Two very important ingredients for effecting change in a culture are leadership, and information sharing. The hospital through its implementation of TQM and ERP systems had already developed the necessary leadership for Six-Sigma, and through its development of ERP system offered total process transparency to all its employees and partners. The implementation of Enterprise Resource Planning (ERP) system helped the hospital in integrating departments and functions to achieve a true process focus. It is important to recognize that their ERP project was not led by the Information systems (IS) department, rather IS in partnership with the hospital business managers led the project. The ERP project was successful because the hospital business managers had a firm understanding of the business processes to determine the appropriate technical architecture for the ERP system. The ERP project further strengthened the hospitals ability to focus on process improvement efforts, to identify its value chain, and team based management by removing the cultural obstacles.

The competency based perspective is based on the premise that a company needs to have the assets, resources, and the skills necessary to perform some

selected activities systematically in order to achieve a better competitive position in the market (Sanchez *et al.*, 1996; Eriksen and Mikkelsen, 1996). According to these authors, the competencies have a cognitive aspect, in terms of knowledge and skills the company possesses, and an action aspect that enables a company to deploy its competencies in a coordinated manner. These competencies also include both personal and corporate competencies (Turner and Crawford, 1994) that are very critical for Six-Sigma implementation. Personal competencies, held by individuals in the form of technical knowledge and charisma, help create the Six-Sigma champions/black belts/green belts cadre in the company. Corporate competencies in terms of Six-Sigma implementation consist of combination of skills and knowledge/experience that enable a firm to implement such a program successfully. These skills and knowledge are embedded in the corporate culture and work methods, and they can only develop through continual process improvement efforts. A company, manufacturing or service, that has gone through TQM, CQI, BPR, or some form comprehensive quality program that focused on customer preferences, continuous process improvement, workforce culture, and a process view of the firm has the basic competencies needed for Six-Sigma. Our study hospital fit that description.

Six-Sigma Implementation at the Hospital

Like Motorola and GE, the hospital decided to relate their quality measures to a process or a group of processes that can be modified to improve outcomes and offer both qualitative and quantitative results. Under TQM, the task of a coordinated improvement effort in all functions and processes at the hospital appeared staggering, Six-Sigma offered a more pragmatic approach because it tries to improve a small segment or function at a time. In the third quarter of 2002, the hospital entered a two-year consulting/benchmarking agreement with GE medical systems, a nationally known consulting company in the healthcare field, for directional support in implementing Six-Sigma. The program chalked out a seven-step change acceleration process (CAP) that utilizes a set of tools to communicate, evaluate, train, and to put the change initiative in motion. The Six-Sigma effort was headed by an implementation team consisting of hospital executives, medical department heads, and support service department heads that had a clear charter from top management on launching this project. One of the first things the GE medical systems did was to assess the organization's track record in quality performance to date. Next, the implementation team focused on the current state-of-affairs regarding readiness in launching the seven CAP processes. This was the actual assessment of competency by the implementation team – from both cognitive and action points of view (Sanchez *et al.*, 1996; Eriksen and Mikkelsen, 1996) – for launching this program. The hospital hired a trained Six-Sigma champion from the GE medical systems, and the implementation team decided to appoint a change agent (either a black belt or a green belt) through a nomination process for each process change initiative. Each change agent leads a team of process owners who have a stake in improving the selected process.

The hospital identified a common set of principles essential for successful implementation of Six-Sigma. These include strong top management and physician leadership and commitment; customer/patient satisfaction focus; project selection based on financial analysis; employee involvement and empowerment; a focus on continuous process improvement; education and leadership training; supplier partnerships; and the recognition of quality as a strategic management issue (Kivirnaki *et al.*, 1997; McNabb and Sepic, 1995; Shin *et al.*, 1998; Zabada *et al.*, 1998). The hospital had a head start on many of these aspects while implementing TQM (Huq and Martin, 2001); this time they had a more focused approach to select the processes for improvement and leadership training. The implementation team also realized the importance of aligning the selected Six-Sigma projects with the organizational strategic plan, ensuring that there is a clear link between the project and overall organizational direction.

The seven step CAP started with selection of the projects for improvement, the implementation team was responsible for this step. Since this was the most critical step in CAP, the implementation team was duty-bound to tap both individual and organizational expertise in this matter. Projects that are assessed to have the most profound impact on hospital bottom-line, market share, and patient satisfaction were selected. Both physicians and hospital administration jointly shared the leadership of the implementation team – a point made by other hospital research studies (Carman *et al.*, 1996; Weiner *et al.*, 1997; Zabada *et al.*, 1998). Physician involvement and direction from the beginning of Six-Sigma implementation was viewed as a key to success because the pathway was driven by the physicians order set. Other members of the implementation team came from the finance department, customer relations, human resources department, nursing, and other support services.

Once a project was selected, it went through other steps of CAP that follow the Six-Sigma acronym, 'DMAIC' (define, measure, analyze, improve, and control). The hospital divided the define step in two clear phases, the first phase defines the problem through identification of common causes and special causes, and the second phase looks at the voice of the customer – both internal and external. The statistical process control procedures and customer feedback processes established for TQM implementation earlier helped this step. The next step in CAP is 'measure current performance' that looks at the input variables and output variables of the selected process. Once these input and output variables are quantified a transfer function can be developed to define the relationship of variables that can help control a process better. Coupled with this use of detailed process mapping tools helped the project team to understand where problems occur within the process.

Next among the CAP activities is 'analyze key relationships' to examine the causes of the process problem. Data collection is done at this stage to determine the different input variables that affect the key output variables that enables the project team to identify the opportunities for improvement. The hospital's experience with data collection and analyses through its implementation of TQM and ERP was very valuable. The next CAP activity is 'improve' phase, that looks at the variables identified in the analyze phase which had the highest impact on the output variables. When key relationships are identified, the

project team spends time on the areas of opportunity, which will have the greatest positive impact on process outcome. Finally, in the 'control phase', the implemented changes are sustained and monitored.

An Example Six-Sigma Project

During the implementation of TQM, the hospital studied all its volume care processes that resulted in the development and documentation of a critical path for each of these processes. One such critical path was designed for the cardiac catheterization laboratory because it is a high volume patient care process. At the end of 2001, the hospital realized that 40 percent of the cases at this lab did not start on time, and patient throughput was inefficient. The Six-Sigma implementation team selected the cardiac catheterization lab. as one of its first projects, they appointed a master black belt to head the project team. The project team created a high-level process map to visualize the progress of patients through the process. This listed patient arrival, patient prepping for the procedure, catheterization procedure, patient holding room stay, and transfer of patient. During the measure phase, the project team collected data on cycle times and all aspects of the process. The collected data were compared with standard estimates based on flow-times for each of the sub-procedures. The comparative analysis helped the project team to evaluate current performance, and to determine how much improvement is needed to be the market leader. The current performance indicated that only 21% of the cases started the procedure within 15 min of the scheduled time, and 62% did not start on time. Detailed analysis of the procedure segment cycle times revealed wide variations; the coefficient of variation for patient workup was 55%, but the highest variation occurred in the actual procedure and in the post procedure holding room, with the coefficient of variation being 155% and 100% respectively. The project team, being well versed in TQM tools and procedures, knew that the key to improving performance would be first to find the root causes by examining the grass-root contributors. A cause and effect diagram identified the critical to quality variables, and measurements obtained indicated a less than ideal situation. For example, in only 73% of cases IV was started on time, EKG completed on time was 81%, and lab. work completed on time was 88%. Physician arrival time was also identified as a critical variable, arrival lateness ranged from 3–45 min with an average of 16 min.

The project was managed closely, change management tools along with Six-Sigma ensured acceptance by employees. To ensure smooth flow, 'start time' was defined and approved by all staff, a newly designed checklist ensured that upstream activities were completed, and 12-hour shifts were introduced. Processes were put in place to guarantee that 100% of all IV's are started. EKG and lab. work is completed. All physicians received pagers or cell phones, and they are now paged 45 min before the start of a case. New transport technicians were hired, cardiac catheterization lab. in addition, assigned environment service staff to expedite the process, and staff were given keys to 'lock out' elevators for transporting emergency patients.

These improvements led to reduction of throughput times by 27 min resulting in increase in capacity of the catheterization lab by 50%, that translates into

\$2 million extra revenue. The coefficient of variation for each of the sub-processes went down by a factor of 50–90%. The project team realized that some variation is unavoidable because of the job-shop nature of the process. Overall, the Six-Sigma program was a success, and it continues to bring positive results in many other processes where they applied it.

Lessons and Insights

Evidence from literature and the case study suggests that Six-Sigma requires certain competency for its successful implementation. Six-Sigma is an approach to improving competitive position of a firm, and it offers a tool-set and a mind-set to reach the lofty goal of 3.4 DPMO to accomplish that. The tool-set and the mind-set becomes effective only in cases where a firm has built up its skills, knowledge, resources and the ability to apply them in a coordinated manner. Although Six-Sigma takes an evolutionary process to change a firm, there are situations where a firm needs radical transformation of its key processes. The basic internal processes necessary for this paradigm shift within the firm includes: (1) changing organization structure in order to better identify and improve processes; (2) using a quality oriented information systems to study processes; and (3) empowering employees and/or creating cross-functional teams to take charge of their operations in a manner that encourages continuous learning as well as personal responsibility. In cases, where a firm does not have clearly defined processes such transformation or improvement is not possible. The case hospital presented in the paper makes that point; through implementations of TQM and ERP systems, the hospital had created a critical path for each volume care process. The hospital was ready for Six-Sigma because it had captured enough process performance data, its employees were very knowledgeable about process flow, and were trained in Six-Sigma tools.

Six-Sigma requires financial rigor in project selection, this is where it deviates from TQM. Applying financial analyses to Six-Sigma improvement efforts offer transparency and credibility to a selected project that helps obtain employee commitment. To review and validate the financial benefits of a selected project the firm must have reliable data about the selected project, an established ERP system or a data warehouse can help this process. Since Six-Sigma is a data driven methodology, such systems will also help in other decision-making activities.

Although empirical research on determination of competency resources – as to how they are formed or acquired – remains rare (Williamson, 1999; Pfeifer *et al.*, 2004) have shown that companies with established quality systems can easily integrate Six-Sigma because they fulfill the prerequisites for Six-Sigma. A firm planning to implement Six-Sigma must develop a checklist of both organizational and individual competencies and assess its learning capabilities. The study hospital, having years of experience in TQM, ERP *vis-à-vis* BPR, had made these assessments to launch its Six-Sigma program. It was easy for them to establish an organizational structure to help achieve its project objectives by employing well-qualified managerial staff and third party Six-Sigma vendors.

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